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Research Article

Proposal of Artifact to Measure Degree  
of Boldness in Business Social Actors

Nelson Rogeri<sup>1</sup>  
Manuel Meireles<sup>1</sup>  
Cida Sanches<sup>1</sup>  
Samuel Ferreira Jr.<sup>1</sup>  
Marcio Luiz Marietto<sup>2,3</sup>

<sup>1</sup>Centro Universitário Campo Limpo Paulista, Campo Limpo Paulista, SP, Brazil

<sup>2</sup>Instituto Politécnico de Leiria, Leiria, Portugal

<sup>3</sup>Universidade do Contestado, Mafra, SC, Brazil

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## Abstract

This work proposes an artifact oriented by Design Science (DS) methods for measuring the degree of boldness in business social actors, especially entrepreneurs and businesspeople. To construct the artifact, the work of Eysenck and Wilson (1975) was used. The methodological approach used was Design Science, as the present object of study is considered an information artifact and, as such, has functions of data processing, reducing entropy (vision of syntax), forming meaning (vision of representation), and achieving viability (vision of adaptation). To ensure the validity of the study, a sample of users made up of 30 organizational psychologists was used, selected by convenience. The results demonstrated that using the artifact allows to measure entrepreneurs' degree of boldness, affording them greater assertiveness in choosing and structuring their business. The study has a number of implications for managerial practice since by using the artifact it is possible to measure an entrepreneur's degree of boldness and allow more assertive choices and structuring of their business, all the while reducing the rate of micro and small businesses that die early. In the academic field, the artifact will enable research on the degree of boldness of businesspeople with diverse other organizational variables.

**Keywords:** boldness calculator; IS artifact; causal determinant; KSG; design science.

## Introduction

This study discusses an artifact oriented by Design Science (DS) methods called Boldness Calculator, available for download, in two languages, in <http://www.boldnesscalculator.com/>. According to Hevner, March, Park and Ram (2004), there are four types of artifacts: “constructs (vocabulary and symbols), models (abstractions and representations), methods (algorithms and practices), and instantiations (implemented and prototype systems)” (p. 79). The implemented artifact is an instantiation. Its origin can be explained, in accordance with Peffers, Tuunanen, Rothenberger and Chatterjee (2007) with regard to the motivation to begin or continue a Design Science Research, by an entry point that identifies and defines the problem to be solved by an artifact – in other words, to conceptualize the problem, which is done below.

By boldness, Eysenck and Wilson (1975) meant a subject’s tendency to take risks. Subjects with a high score for boldness like to live dangerously and seek rewards without worrying about unfavorable consequences. Characteristically speaking, they are the players who believe that taking a certain amount of risk adds flavor to life. Low levels indicate a preference for intimacy, safety, and protection, even though it represents the sacrifice of some exciting aspects of life. The boldness factor is very closely linked to impulsivity.

The proposal of this study on the Boldness Calculator lies precisely within the domain of an IS Artifact. The study aims to help bridge the aforementioned gap, as works in this field remain scarce. The intention is to propose a method and its corresponding artifact, based on the protocols of DS, to measure the degree of boldness of subjects, especially entrepreneurs and businesspeople. The artifact could be considered an IS Artifact, since it uses a technological artifact (software), an information artifact (research data), and a social artifact (level of boldness of entrepreneurs, managers and, operators of organizations).

We used the theoretical assumptions of Eysenck and Wilson (1975) to develop the Boldness Calculator. They established a hierarchical (trait-factor) model of personality that provides the rationale and interpretive bases for the questionnaires that measure meaningful aspects of personality. This model allowed, through various studies, to observe that certain personal characteristics of business social actors and entrepreneurs are associated with their success in creating jobs and opportunities in organizations (Akyol, 2016; Nair & Pandey, 2006). This trait is known by a number of names: risk-taking propensity (Antoncic et al., 2018), self-confidence (Gelaidan & Abdullateef, 2017), openness to experience (Ngek, 2015), proactive personality (Kim, 2018), courage (Comer & Sekerka, 2018), aggressiveness (Ferrier, 2001), impulsiveness (Brown, Packard, & Bylund, 2018), anxiety (Jensen, Patel, & Messersmith, 2013); oriented realization (Galloway & Mochrie, 2006), and obsession (Fisher, Merlot, & Johnson, 2018).

Despite the importance of boldness as a personality trait of entrepreneurs and businesspeople, especially in the dynamic of companies, there is no tool for interested parties to measure the degree of boldness of an entrepreneur, manager, or operator. There are several tools to measure risk propensity: (a) Sorrentino, Hewitt, and Raso-Knott (1992) proposed a scale for risk-taking in skilled and chance situations; (b) the Domain-Specific Risk-Taking scale (DOSPERT), developed

by Weber, Blais, and Betz (2002), measures the tendency to engage in real-life risk-taking behavior; (c) a scale in the field of psychology proposed by Kruger, Wang, and Wilke (2007), who identified five domains of risk-taking: between-group competition, within-group competition, mating and resource allocation for mate attraction, environmental risks, and fertility risks; and (d) passive risk taking (PRT), which is a scale based on the riskier choice as the one with the greater outcome variance (Keinan & Bereby-Meyer, 2012).

As shown by the brief descriptions above, none of these scales is deemed appropriate for application in the field of entrepreneurship or organizations of any size. Therefore, the proposal of an artifact is fully justified. For this, our main objective was to describe the development of an artifact oriented by Design Science (DS) methods that serve for human purposes (March & Smith, 1995). In this work, it serves to business social actors. The Eysenck and Wilson (1975) theory option was only for the experimental test version of artifact. To reach the objective, we used 30 organizational psychologists, selected by convenience, to test the artifact. The main result was the statistic validation of the artifact. In the future, we expect that, with the development and adjustments of the artifact, further research will explore a deeper theoretical basis on the issue and apply the research on business social actors.

## Literature Review

### Information system (IS) artifact: Beyond DS application in information technology (IT) business area

One of the proposals for understanding the application of DS in the field of business, specifically in information technology (IT), was outlined by March and Smith (1995). The authors explained that DS is intended to create things that serve human purposes, unlike the natural and social sciences, which attempt to understand and explain reality. The authors described the structure of DS in two axes: (a) the research activities, which include constructing, evaluating, theorizing, and justifying the artifact; and (b) the research results, which include the constructs, models, methods, and instantiations.

The creation of an artifact in DS focusing on businesses in IT is the core purpose of the field. To Simon (1996), artifacts are everything that is not natural, something constructed by man. Consequently, artificial IT systems are constructed and implemented within an organization to improve its efficiency. In IT, artifacts are broadly defined as constructs (vocabulary and symbols), models (abstractions and representations), methods (algorithms and practices), and instantiations (implementation and prototypes of systems) (Hevner, March, Park, & Ram, 2004). Some examples of the creation of artifacts in organizations using DS in the field of IT were listed by De Sordi, Meireles, and Sanches (2011), Druckenmiller and Acar (2009), Nan and Johnston (2009), and Atkinson, Gutheil and Kennel (2009). Other examples of the use of DS in the IT of organizations can be found in Markus, Majchrzak, and Gasser (2002), Walls, Widmeyer, and El Sawy (1992), and Nunamaker, Dennis, Valacich, Vogel and George (1991).

However, DS has yet to achieve a consistent body of constructed artifacts intended for use outside the IT area of organizations – in other words, the construction of artifacts that were not designed for the IT area and were created by people who are not specialists or designers in this area. These are different artifacts that are proposed in order to solve problems or achieve the goals of individuals, groups, organizations, societies, and/or other social units (Lee, Thomas, & Baskerville, 2015). The aim of this study is to help bridge this gap, or, in other words, to present an artifact intended to solve a problem outside the IT field – an artifact constructed by people outside that area to solve a non-IT problem.

Lee, Thomas, and Baskerville (2015) explained that, although aspects of technology are present, the extensions of DS could include social and technology artifacts, as well as cultural properties, and incorporate people, policies and social practices. The authors expanded Simon's (1996) understanding of the definition of artifact and defined technology artifact, information artifact, and social artifact to propose the concept of information systems artifact (IS Artifact).

A technology artifact is a tool created by man. Its purpose is to solve a problem, achieve a goal, or serve a purpose that can only be defined, felt, and perceived by human beings. This kind of artifact does not necessarily need to be digital or electronic. It could be a book or a library. Even a hammer is considered a technology artifact. An information artifact is an instantiation of information, in which the instantiation occurs through a human act, either directly (e.g., a verbal or written declaration of a fact) or indirectly (e.g., the execution of a computer program to produce a quarterly report). The functions of an information artifact are to: (a) process data; (b) reduce entropy (vision of syntax); (c) form meaning (vision of representation); and (d) achieve viability (vision of adaptation). Examples of information artifacts are numbers, letters and symbols that are devoid of content, but to which content can be attributed so that it can be processed, relationships between these numbers, letters and symbols such as algebraic relationships between variables and constructs in an equation, or even grammatical relationships between letters and punctuation that form a paragraph. A social artifact consists of (or incorporates) social relationships or interactions between individuals through which they attempt to solve their problems, achieve their goals, or serve their purposes. Thus defined, social artifacts may include institutionalized social objects that involve already established relationships (such as kinship structures, institutions, cultures, and laws), as well as ephemeral social facts or events in one-off interactions (such as the content of a conversation, a decision made at a committee meeting, or an act of charity) (Lee et al., 2015).

Finally, the authors defined the IS Artifact as the combination of the three previously defined artifacts. The meaning is greater than only the concatenation of a technology artifact, an information artifact, and a social artifact. The IS Artifact emerges from the interactions of the different properties of the constituent artifacts. An IS Artifact is a system, in which the whole is greater than the sum of the parts (the IT Artifact, the social artifact, and the information artifact), and its constituents are not separated, but interact like any subsystems of a system.

To provide examples of their definition of an IS Artifact, Lee et al. (2015) used three cases as an illustration. The first case addressed the study of Emery and Trist (1969) regarding a socio-

technical system that involved the creation of an extraction method for miners in a coalmine. The artifact used other artifacts: one technological, one information, and one social, but did not involve information technology. The second case was the creation of an information system with an information technology artifact, but without IT designers and/or specialists (Luo, 2006). The study addressed the creation of a social interaction network operationalized through home telephones or cell phones in an attempt to mitigate the spiritual needs and social and cultural difficulties experienced by Chinese immigrants when they arrived in the USA. The immigrants, who were located in different parts of the USA, arranged their telephone calls at the same time as Pastor Chen preached in church, allowing them to participate in his activities. Later, the church acquired 40 telephone lines, although they were not enough to satisfy the demand for 100 calls at a time in a conference call system. The result could be considered an IS Artifact, since it emerged from the interactions of a technology artifact, an information artifact, and a social artifact, albeit without the participation of IT specialists and/or designers. The third study was a case of small data, low tech, and information systems success – the creation of a largely unsophisticated IT Artifact that obeyed DS protocols. The project involved the use of mobile telephones to track and promote women's health in a community characterized by minimum socio-economic levels and low literacy rates in the village of Ernakulam in the state of Kerala in India. The women were taught to use text messages by simply inserting and sending certain one- or two-digit numerical codes to report their state of health and requirements. A technology artifact was added for doctors to use – an electronic dashboard with filing resources that allowed doctors to gauge how serious a patient's health problem was and evaluate the medical records that charted her illness. This artifact allowed medical services to reach geographical regions of the community that had hitherto been isolated and where communication was very difficult. The creation of the technology artifact involved an information artifact for monitoring diseases among the women that lived in places that were difficult to reach, strengthening the social artifact in the form of social relations, improving interactions between doctors and patients. The technology artifacts, social artifacts, and information artifacts all support each other's functioning forming, together, an IS Artifact.

Finally, to reaffirm the theoretical importance of this study, we demonstrate one more application of DS in the creation of an IS Artifact in the field of business. Osterwalder (2004) created an artifact (model), also based on DS protocols, that conceptually enables the expression of the business logic of a company in a structured way. His business tool (software) was intended to: (a) identify the key concepts and relationships within a domain of interest of the organization (in other words, scoping the company business model); (b) produce precise unambiguous text definitions for these concepts and relationships; (c) identify the terms to refer to such concepts and relationships; and (d) agree on all the above items. This generated the IS Artifact, which the author called the business model ontology.

## Theoretical framework

To construct the artifact, given the proximity of the existing theoretical constructs, the work of Eysenck and Wilson (1975) was used as a theoretical framework, with this choice being justified by the considerations of West (2012). According to this author:

Eysenck and Wilson hold with the primacy of genetic factors as the determinants of personality. The role of the environment, we are told, is limited to “effecting slight changes and perhaps a kind of cover-up” (p. 20). Since there is really very little we can do to change our personality in any fundamental sense, we may be well advised to submit to reality, discover who we are by whatever means available to us, and plan our life in the light of that knowledge. (West, 2012, p. 195)

West concludes:

Know Your Own Personality introduces the reader to Eysenck’s hierarchical (trait-factor) model of personality. This model provides the rationale and interpretive bases for the questionnaires which follow. The questionnaires per se have serious pretensions to measuring meaningful aspects of personality and must not be regarded as merely illustrative material or as “journalistic playthings”. With the rigour characteristic of Eysenck’s work, these scales have been scientifically constructed, validated, and normed. (2012, p. 196)

From the work of Eysenck and Wilson (1975), as shown below, eight personality traits most closely associated with a personality of boldness were selected, hereafter referred to factors: boldness, impulsivity, oriented realization, responsibility, aggressiveness, anxiety, manipulation, and dogmatism. For each of these factors, the authors Eysenck and Wilson (1975) developed a questionnaire with 30 questions, some of them inverted.

Those with a high score in impulsivity, according to Eysenck and Wilson (1975), feel inclined to act on the spur of the moment, frequently making rushed and immature decisions, and are habitually unconcerned, changeable, and unpredictable. Those with low scores consider the facts more carefully before making a decision. They are systematic, methodical, and cautious and like to plan their lives. They think before they speak and look before they leap.

Subjects with high scores in oriented realization, according to Eysenck and Wilson (1975), are ambitious, hard-working, competitive, and eager to improve their social position. They value productivity and creativity very highly. Subjects with low scores in oriented realization are not greatly concerned with competitive performance or creative achievements. Many are apathetic, withdrawn, and without goals.

Subjects with responsibility, according to Eysenck and Wilson (1975), tend to be more conscientious, dependable, trustworthy, and with a circumspect mentality, possibly not very compulsive. Those with low scores in responsibility tend to be unconcerned, indifferent to protocols, and fall behind in their commitments. The last four factors considered are aggressiveness, anxiety, manipulation, and dogmatism.

The behavior of subjects with aggressiveness, according to Eysenck and Wilson (1975), is rash, subject to mood swings, heated arguments, and sarcasm. They are also easily irritated. Subjects with low scores are gentle and balanced and prefer to avoid personal conflicts. People with high scores for anxiety are easily upset when things go wrong and they worry unnecessarily about what may or may not happen. Those that score few points are placid, serene, and resistant to irrational fears and anxieties.

Subjects with high scores in manipulation are dispassionate, predictive, shrewd, and expedient. They have knowledge of the world and are interested in themselves when dealing with other people. Those with low scores are generous, trusting, sober, and altruistic, with an ability to identify with others to understand them better. This characteristic is sometimes “known as Machiavellian as it corresponds to a certain point with the political philosophy outlined by the Italian writer Niccolo Machiavelli” (Eysenck & Wilson, 1975, p. 112).

Subjects with a high score in dogmatism demonstrate intransigent points of view on most subjects and are likely to defend them firmly in a loud and clear voice. Those with low scores are less inflexible and less inclined to see everything as black or white. They are open to rational persuasion and highly tolerant of uncertainty.

To evaluate the respondent’s attitude to the factors of each personality trait, Eysenck and Wilson (1975) provided for each of them 30 questions that require a “yes” or “no” answer, some of them inverted. The questions are mixed so that, for instance, to evaluate the degree of a respondent’s impulsivity, the authors take into account questions (-4) (11) (18) (-25), etc. Questions (4) and (25) in this example are of opposite signs, indicating that a negative response helps to determine the respondent as impulsive. In an analysis table, the authors place the respondent between two extreme points: boldness/prudence, impulsivity/control, oriented realization/lack of ambition, responsibility/irresponsibility, aggressiveness/tranquility, anxiety/tranquility, manipulation/empathy, and dogmatism/flexibility.

In the following sections, the method is presented along with a description of the artifact, which used the above concepts and structure with two adjustments: (a) the 30 questions for each factor were reduced to 10 to streamline the process (and the questions considered were chosen by consensus by the study group of organizational psychologists); (b) the dichotomous questions were converted into propositions on a Likert scale with five semantic differentials (I totally disagree, I disagree, Indifferent, I agree, and I totally agree).

## Method

Design Science Research (DSR) is a research strategy. The differences from the more common explanatory research strategy lie at the level of strategy. There are, in principle, no differences at the tactical level of methods for data gathering and data analysis; DSR does not need specific methods at this tactical level (Van Aken, Chandrasekaran, & Halman, 2016). Therefore, this study follows the approach established for DSR proposed by Gregor and Hevner (2013): (a) introduction, with a definition of the problem and research goals necessary for the developed artifact; (b) literature review, showing previous studies relevant to the study, including any theory or knowledge from a previous project; (c) method, indicating the research approach that was employed; (d) description of the artifact, with a concise explanation at the appropriate level of abstraction to create a new contribution to the knowledge base; (e) evaluation, proving that the artifact is useful and valuable considering the following criteria: validity, utility, quality, and efficacy; (f) discussion, addressing the interpretation of the results, especially what the results



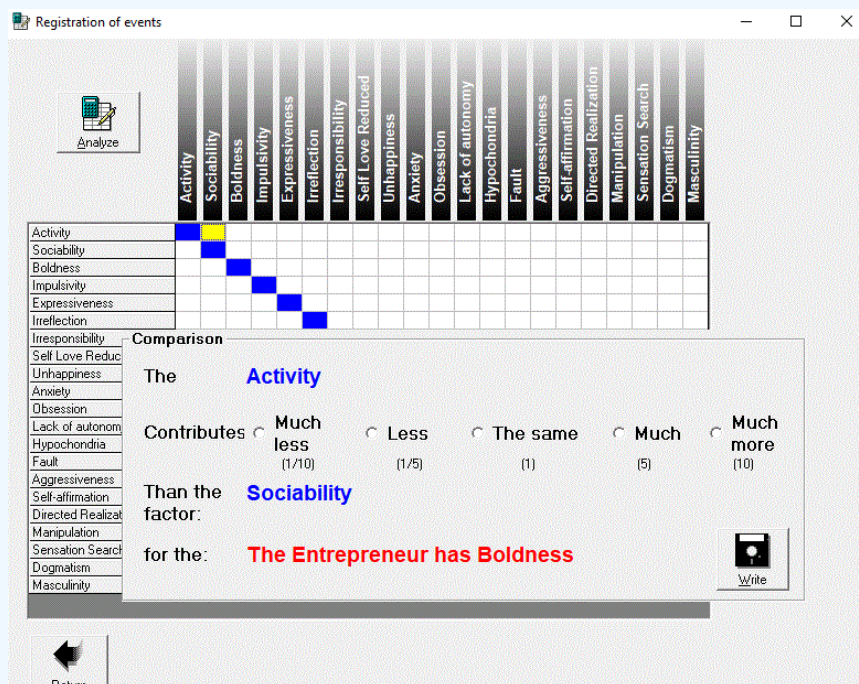
mean and how they are related to the objectives; the implications of the results must be discussed; and (g) conclusions that reaffirm the important discoveries of the work. The present work as a whole falls within this scope. Below, specific details are given regarding the methodological questions observed in this study.

The study is qualitative-quantitative and based on primary data extracted from the application of the artifact. A study is considered qualitative-quantitative when the variables are ordinal.

The study sample was made up of 30 organizational psychologists selected by convenience, as they had previously agreed to test the artifact and give an opinion on it. To prove the validity after reduction we analyze Cronbach's Alpha and get the value 0.826 of Cronbach's Alpha. The result suggests an adequate reliability since an  $\alpha$  value of at least 0.7 reflects acceptable reliability, according to Nunnally (1978). To construct the scale that serves as the basis for the construction of the artifact, the framework of Eysenck and Wilson (1975) was used with characteristics associated with boldness. From the extensive list of characteristics provided by these authors, a study group made up of three organizational psychologists selected three personality traits and their factors: (a) extroversion (sociability, impulsivity, boldness, expressiveness, lack of reflection, and irresponsibility); (b) emotional instability (low self-esteem, unhappiness, anxiety, obsession, lack of autonomy, hypochondria, and guilt); and (c) mental inflexibility (aggressiveness, assertiveness, oriented realization, manipulation, sensation seeking, dogmatism, and masculinity-femininity).

The three psychologists have worked in organizations for over 20 years and are university professors in the field of Psychology of Work and Organizations with extensive academic experience. They were chosen for convenience and acted on the framework of the Eysenck and Wilson's work (1975).

The study group, by consensus, operating the Causal Determinant software (available at <http://www.causaldeterminant.com/en/site-en.html>), analyzed the 21 previously selected factors. This method was suggested by works by Hickling, Wellman, and Gottfried (1997) and Zamir (2010).



**Figure 1.** Window of the Causal Determinant to determine the causal factor of an entrepreneur's boldness

According to Sanches, Meireles, and da Silva, an

analysis table is opened and the Prioritization Matrix is ready to receive the analysts' decisions. The Prioritization Matrix has the same number of rows and columns where all the considered factors arise. To proceed with the analysis, click on a cell right of the diagonal. Clicking below the diagonal, nothing will happen, for these cells are frozen. In Figure 1, the cursor was positioned over the first cell to the right of the diagonal. The cell is activated and highlighted in yellow, and a cell will appear enabling two personality traits to be compared. Decisions on the value of a contributing factor (much less/less/the same/more/much more) in relation to another should be made by two or three people familiar with the problem. Scarpi (2010), Dong et al. (2010) and many other authors recommend attributing points by consensus. (2015, p. 6)

The organizational psychologists analyzed each cell to the right of the diagonal and by consensus chose the most logical value.

After making all the comparisons, click on "Analyze" to obtain a report with specific scores, as shown in Figure 2. The software shows the sums of the "line points" and the "column points." As the sums of the lines and columns constitute different amplitudes, it is necessary to resort to normalization to provide the two sums of equivalent amplitudes, both varying in the interval [0; 5]. The normalized values represent a class of statistical proportions constructed with a specific formula to compare two measurements in different locations, in this case, the sum of the lines and columns.

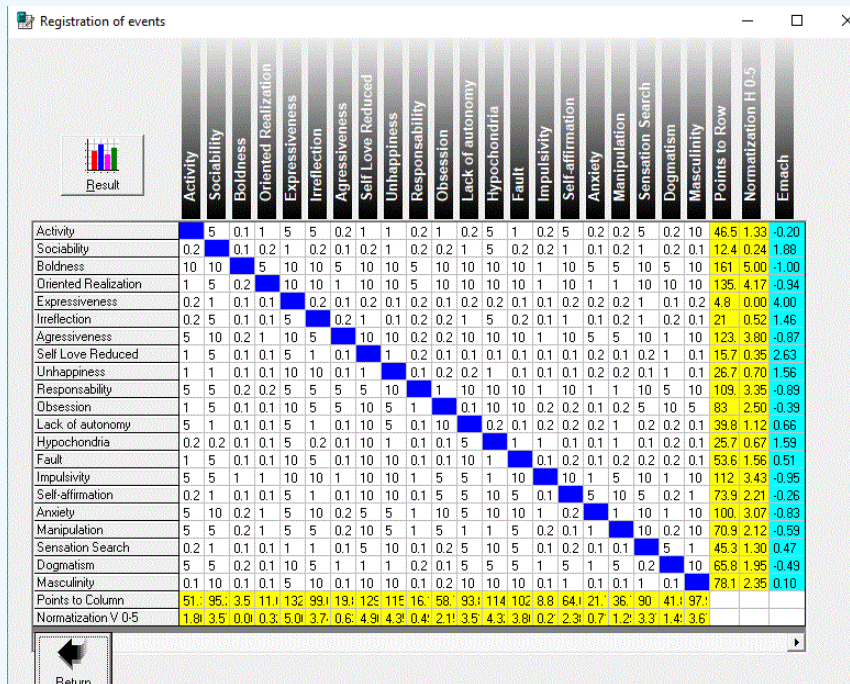


Figure 2. Emach calculation

The normalizations, according to Sanches et al., are:

- 1) H (or horizontal) normalization, corresponding to the normalization of the totals in the rows in the 0-5 interval (H normalization column 0-5);
- 2) V (or vertical) normalization, corresponding to the normalization of the totals of the columns in the 0-5 interval (V normalization row 0-5). Both V and H normalization are calculated using the formula:  $I_p = 5 \cdot \frac{p - \min}{\max - \min}$  where p is the number of points, min is the lowest observed factor and max the highest. The normalization follows the recommendations of Dodge (2003). (2015, p. 7)

In addition to the normalization, the software calculates a variable for each factor (the Emach), and calculated thus:  $Emach_{HV} = \frac{V}{H+1} - 1$ . For “Activity,” the H value is 1.33 and the V value is

$$1.86, \text{ with } Emach_{HV} = \frac{V}{H+1} - 1 = \frac{1.86}{1.33+1} - 1 = -0.20$$

To Sanches et al. (2015), the “Emach expresses the meaning and power of the factor in the cause and effect (C-E) relationship” (p. 8). The Emach calculation enables information regarding the “degree of causality”: causal factors are negative and effect factors are positive. The higher the value of the Emach, the greater the effect it has. The Emach limits are -1 (root cause) and 4, the main symptom of the effect. According to Figure 2, expressiveness is the main symptom of the effect. The root cause is the factor with an Emach of -1: in this case, boldness.

Thus, eight factors were selected from the personality traits that, according to the study group of organizational psychologists, are more closely associated with a personality of boldness (the respective Emach is in parenthesis): boldness (-1), impulsivity (-0.95), oriented realization (-0.94),

responsibility (-0.89), aggressiveness (-0.87), anxiety (-0.83), manipulation (-0.59), and dogmatism (-0.49).

Two types of variables were used: (a) inherent to the operationalization of the artifact and (b) related to the validation of the artifact by users. Regarding the former, we have the following: degree of adherence to the factor (daf), indicating the respondent's degree of adherence to each of the eight factors; type that indicates the level of boldness of the user and which can have four values: +3, +1, -1, and -3; dob: degree of boldness, with values in the interval [+1;-1]. The latter variables refer to the use and evaluation of the artifact:  $\lambda^2$  KSG (chi-square of the Kolmogorov-Smirnov-Goodman test); maximum D: highest difference observed; chi-square: calculated in accordance with Equation (3); p-value: calculated in accordance with Equation (6).

The data were treated quantitatively using non-parametric techniques.

## Artifact Description

In this section, a synthetic description of the artifact is given. The artifact is called the Boldness Calculator. It is software containing a method and an instantiation. The method is the one described by Eysenck and Wilson (1975), especially the part associated with determining a subject's degree of boldness. The artifact is made to analyze and calculate a subject's degree of boldness based on the principles of Eysenck and Wilson (1975), and it is useful for entrepreneurs and company managers to know the boldness of their subordinates or to know themselves.

As it is presented as software, the artifact is abstract. It was constructed using the Visual Basic programming language. The artifact can be widely applied in any department of an organizational environment. It is especially useful to the Human Resources area in selecting candidates when the personality trait of boldness is relevant (necessary or unnecessary). The target audience is made up of entrepreneurs, businesspeople, human resources managers, and organizational psychologists.

The artifact is processed in three fundamental windows: (a) register to collect data on the respondent; this window can be customized, but contains the following minimum information: date, name, profession, and sex; (b) a set of eight questionnaires in the form of a five-point Likert scale, each with ten propositions; (c) analysis that presents the level of the respondent with regard to boldness, impulsivity, oriented realization, responsibility, aggressiveness, anxiety, manipulation, and dogmatism. In addition to the level associated with each factor, it also presents the daf and the signal. These concepts are seen below. The profile (dob and Type) is part of the analysis, as well as the profile description. To understand how the artifact operates the concept, questionnaire (3/8) is shown as an example with responses in Figure 3 and treated as shown in Figure 4. In accordance with the theoretical model for a given factor (impulsivity, in the example), there is a set of responses provided by Eysenck and Wilson (1975) that is considered ideal (i) where no=TD=1 and yes=TA=5. The difference observed between the ideal response (i) and the respondent's response (r) is then calculated. Obviously, if the r responses are the same as the ideal responses (i), the difference (i-r) is null and the respondent has the ideal profile. The square of

the observed difference  $(i-r)^2$  is calculated and, finally, the sum of the squared observed difference is obtained. It should be noted that if the difference per proposition is 4 or -4, the square is 16. As there are ten propositions per factor, the maximum sum of the squares of the observed differences is 160. This value enables the calculation of the degree of adherence to the factor:  $daf = 1 - (\text{sum of the differences squared} / 160)$ . In this sense, if the respondent has a profile that is identified with the propositions of Eysenck and Wilson (1975) for the factor, he will have a daf close to 1 or 1; otherwise, if he does not identify with the profile, the daf will be close to zero or zero. In the example, the  $daf=0.938$ .

	DT	D	I	C	CT
I plan my activities in advance.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I change my interests frequently.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
I decide quickly.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
I am restrained.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I decide on the first contact whether I like people.	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
I plan my trips carefully (itineraries and times).	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like going out at night when it is decided at the last minute.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
New ideas are so exciting that I do not even think about possible obstacles.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
I like work that requires concentration all the time.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I always plan (save) patiently to buy something expensive.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Figure 3.** Example of the responses to the questionnaire on the impulsivity factor

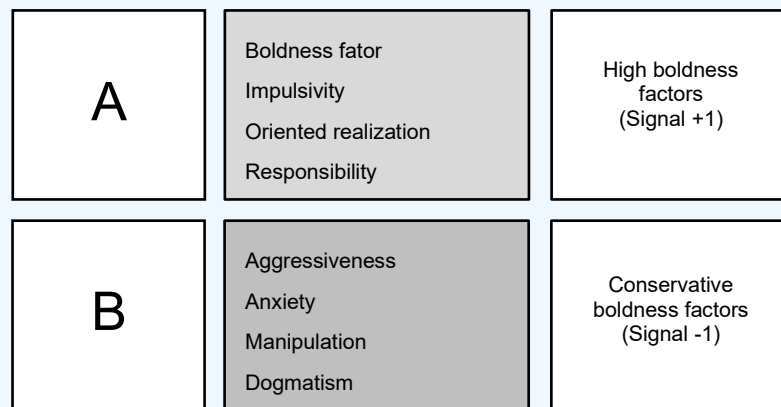
Table 1

**Internal analysis of the responses to factor (3/8) impulsivity**

Propositions	TD	D	I	A	TA	i	i-r	(i-r)^2	Σ(i-r)^2	daf
	1	2	3	4	5					
I plan my activities in advance.			2			1	-1	1		
I change my interests frequently.			4			5	1	1		
I decide quickly.			5			5	0	0		
I am restrained.			1			1	0	0		
I decide on the first contact whether I like people.			3			5	2	4		
I plan my trips carefully (itineraries and times).			2			1	-1	1		
I like going out at night when it is decided at the last minute.			4			5	1	1		
New ideas are so exciting that I do not even think about possible obstacles.			4			5	1	1		
I like work that requires concentration all the time.			2			1	-1	1		
I always plan (save) patiently to buy something expensive.			1			1	0	0	10	0.938

**Note.** Source: Propositions: affirmatives derived from the questionnaire of Eysenck, H., & Wilson, G. (1975). *Know your own personality* (p. 68). South Melbourne, Australia: Macmillan.  
 TD to TA: semantic differential of the Likert scale, ranging from “totally disagree” to “totally agree”; i: ideal response in accordance with Eysenck and Wilson (1975, p. 68), where “no”=1 and “yes”=5; i-r: observed difference between the ideal response and respondent’s response; (i-r)^2: square of the difference observed; Σ (i-r)^2: sum of the squares of the differences observed; daf: degree of adherence to the factor=1-(sum of the squares of the difference/160).

For a complete evaluation, the model considers the joint analysis of the eight factors stratified into two groups, as shown in Figure 4: Group A, with the high boldness factors, with the most significant causal Emachs, and Group B, with the conservative boldness factors, with less significant causal Emachs. To each factor in Group A, the signal +1 is given, and to those in Group B, the signal -1 is given.



**Figure 4.** Stratification of the factors for analysis purposes

The type of respondent with regard to the degree of boldness is determined as shown in the example in Table 2. In this case, the respondent for each factor obtains a certain degree of adherence to the factor (daf). The three factors with the highest daf are considered (in the example, impulsivity, responsibility, and dogmatism). The average of the daf multiplied by the respective signal (daf\*S) gives the degree of boldness (dob).

Table 2

**Example of the determination of the degree of boldness**

Group	Factor	Signal	daf	daf*S
A	Boldness		0,606	
	Impulsivity	+1	0,938	0,938
	Oriented realization		0,569	
	Responsibility	+1	0,775	0,775
B	Aggressiveness		0,488	
	Anxiety		0,731	
	Manipulation		0,444	
	Dogmatism	-1	0,838	-0,838
<b>Type=</b>		<b>+1</b>	<b>dob=</b>	<b>0,292</b>

**Note.** Group: Groups A and B of factors, considering that the factors in Group A indicate high boldness and those in Group B indicate conservative boldness; Factor: name of the factors considered in the analysis; Signal: for the purpose of stratification, high factors have signal 1 and conservative factors have the signal -1; daf: degree of adherence to the factor, calculated as 1-(sum of the squares of the differences between the responses given and the "ideal" responses/160), the three factors with the highest daf value are highlighted; daf\*S: product of the daf\*S value by the signal; Type: algebraic sum of the signals that can assume four values: +3, +1, -1, and -3; dob: degree of boldness that assumes values in the interval [+1;-1].

The respondent, with regard to boldness, can be one of four possible types, given by the sum of the signs: bold (+3); bold with conservative bias (+1); conservative with bold bias (-1); and conservative (-3). In the example shown in Table 2, the subject type is +1 (bold with conservative bias), with degree of boldness (dob)=0.292.

A logical pilot test was conducted, which observed all the possible responses and gauged whether the analyses and the results were consistent. A validation test was also conducted with the target audience, with field research involving 30 organizational psychologists, who validated the theoretical concept of the artifact by producing responses that, in their understanding, involved a target profile of boldness.

We chose, for convenience, 30 organizational psychologists, 21 of whom are female and 9 are male, with 5 of them in the age group of 25 to 34 years old, 21 between 34 and 60 years old and 4 over 60 years old; 10 psychologists have professional experience between 5 and 10 years; 15 between 11 and 30 years; and 5 with more than 30 years of professional experience. These professionals work in several areas: Commerce (6), Consulting and Education (10), Government (2), Industry (4), Health (4), and Services (4). Their regional locations are also diverse: 26 in the state of São Paulo, 3 in Rio Grande do Sul, and one in state of Rio de Janeiro. The tests were performed in February 2019 in the respondent's native language, although the bilingual version (Portuguese/English) was available.

The theory that supports the construction of the artifact was summarized in second section. It should be highlighted that Eysenck and Wilson (1975) are the fundamental source of the questionnaire on which the artifact is based. Regarding the origin of the conception of the artifact, it should be emphasized that, in the dynamic of companies, there was no tool for interested parties to use that could determine the degree of boldness of an entrepreneur, manager, or organizational operator. There are diverse tools for measuring risk propensity, but none of these has proved appropriate for application in the field of entrepreneurship or organizations of any size. Therefore, the artifact presented in this work is fully justified due to the lack of tools to measure the boldness of individuals. It should be stressed that it is possible for entrepreneurs and organizational psychologists to use the tool when hiring or promoting employees in cases when boldness is a determining factor.

## Evaluation

The proposed method was evaluated using the expertise of 30 organizational psychologists. Each psychologist was asked to incorporate a type of respondent, which was referred to as a target type. For example, one organizational psychologist was asked to respond as if he were a bold person (type 3) or bold with a conservative bias (type 1), or conservative with a bold bias (type -1) or conservative (type -3). Table 3 shows the results and the calculations of the KSG test to analyze the observed results and expected results.

In the Difference D column in Table 3, there is the difference between Accumulated Relative Observed Performance and Accumulated Relative Theoretical Performance. The maximum D

observed is used to conduct the KSG test, which is expressed by a  $\lambda^2$  value (chi-square), as can be seen in Meireles, Sanches, and De Sordi (2013).

According to Schindler (2008), the Kolmogorov–Smirnov (K-S) test is intended to verify whether the differences between the accumulated frequencies of the samples are significantly different from the accumulated frequencies of the theoretical distribution.

With the K-S test, according to Siegel (1960), it is possible to gauge whether two cumulative distributions are in agreement. The test focuses on the highest of the observed deviations, as shown in Equation (1).

$$D = \max D_i = \max |A_{wi} - A_{ti}| \quad (1)$$

Siegel (1960) affirms that it has been shown (Goodman, 1954) that

$$\chi^2 = 4D^2 \frac{n_1 n_2}{n_1 + n_2} \quad (2)$$

Siegel (1960) highlights:

It is interesting to notice that the chi-square approximation may also be used with small samples, but in this case, it leads to a conservative test. That is, the error in the use of the chi-square approximation with small samples is always in the “safe” direction (Goodman, 1954, p. 168 as cited in Siegel, 1960, p. 134).

This means that Goodman’s approximation (2) is applicable to small and large samples. In the present situation, as  $n_1 = n_2$ , Equation (3) can be written.

$$\chi^2 = 4D^2 \frac{n_1 n_2}{n_1 + n_2} = 4D^2 \frac{n^2}{2n} = 2nD^2 \quad (3)$$

In this test, the value of the chi-squared is given by Equation (4), with the adjustment of the K factor shown in Equation (5). This factor allows the chi-square, irrespective of the distribution of the observed values, to be equal to 13.816 for a level of significance of 0.001, which is in agreement with Goodman (1954).

$$\chi^2 = 2nkD^2 \quad (4)$$

$$k = \frac{13.816}{2n(1 - \frac{1}{n})^2} \quad (5)$$

The calculation of level of significance  $\alpha$  through the chi-square is easy to obtain as shown in Equation (6).

$$\alpha = e^{(-0.5\lambda^2)} \quad (6)$$



Table 3

**Performance analysis and KSG test**

#	Target Type	Real Type	Difference	Relative difference	Observed performance	Relative Observed Performance	Accumulated Relative Observed Performance	Expected Performance	Relative Expected Performance	Accumulated Relative Expected Performance	Difference D
6	-1	-1	0	0,00	1,00	0,05	0,05	1	0,03	0,03	0,02
10	-1	-1	0	0,00	1,00	0,05	0,11	1	0,03	0,07	0,04
16	1	1	0	0,00	1,00	0,05	0,16	1	0,03	0,10	0,06
20	-3	-3	0	0,00	1,00	0,05	0,21	1	0,03	0,13	0,08
23	1	1	0	0,00	1,00	0,05	0,26	1	0,03	0,17	0,10
25	1	1	0	0,00	1,00	0,05	0,32	1	0,03	0,20	0,12
29	-1	-1	0	0,00	1,00	0,05	0,37	1	0,03	0,23	0,14
4	-1	1	2	0,33	0,67	0,04	0,40	1	0,03	0,27	0,14
7	1	3	2	0,33	0,67	0,04	0,44	1	0,03	0,30	0,14
13	1	3	2	0,33	0,67	0,04	0,47	1	0,03	0,33	0,14
15	-3	-1	2	0,33	0,67	0,04	0,51	1	0,03	0,37	0,14
19	-3	-1	2	0,33	0,67	0,04	0,54	1	0,03	0,40	0,14
21	1	3	2	0,33	0,67	0,04	0,58	1	0,03	0,43	0,15
27	-1	1	2	0,33	0,67	0,04	0,61	1	0,03	0,47	0,15
1	3	1	-2	0,33	0,67	0,04	0,65	1	0,03	0,50	0,15
2	3	1	-2	0,33	0,67	0,04	0,68	1	0,03	0,53	0,15
14	3	1	-2	0,33	0,67	0,04	0,72	1	0,03	0,57	0,15
17	3	1	-2	0,33	0,67	0,04	0,75	1	0,03	0,60	0,15
26	3	1	-2	0,33	0,67	0,04	0,79	1	0,03	0,63	0,16
30	1	-1	-2	0,33	0,67	0,04	0,82	1	0,03	0,67	0,16
3	-1	3	4	0,67	0,33	0,02	0,84	1	0,03	0,70	0,14
5	-3	1	4	0,67	0,33	0,02	0,86	1	0,03	0,73	0,13
9	-1	3	4	0,67	0,33	0,02	0,88	1	0,03	0,77	0,11
11	-3	1	4	0,67	0,33	0,02	0,89	1	0,03	0,80	0,09
12	-3	1	4	0,67	0,33	0,02	0,91	1	0,03	0,83	0,08
18	-3	1	4	0,67	0,33	0,02	0,93	1	0,03	0,87	0,06
22	-1	3	4	0,67	0,33	0,02	0,95	1	0,03	0,90	0,05
24	-3	1	4	0,67	0,33	0,02	0,96	1	0,03	0,93	0,03
28	-3	1	4	0,67	0,33	0,02	0,98	1	0,03	0,97	0,02
8	3	-1	-4	0,67	0,33	0,02	1,00	1	0,03	1,00	0,00
					<b>19</b>			<b>30</b>	<b>1</b>	Maximum D	0,1579
										Chi-square =	0,3686
										P-value =	0,8317

**Note.** Legend: #: respondent number; Target Type: type of profile to be obtained with the responses of the organizational psychologist (+3, +1, -1, -3); Real Type: type of profile actually obtained with the responses of the organizational psychologist (+3, +1, -1, -3); Difference: difference between the Real Type and Target Type (maximum=6); Relative Difference: Difference/6; Observed Performance: 1-Relative Difference; Relative Observed Performance; Observed Performance/19, which is the sum of the Observed Performance column; Accumulated Relative Observed Performance: accumulated sum of the Relative Observed Performance column; Expected Performance: total accuracy which is equal to 1; Relative Expected Performance: for all cases corresponds to 1/30; Accumulated Relative Expected Performance: accumulated sum of the Relative Expected Performance column; Difference D: difference between Accumulated Relative Observed Performance and Accumulated Relative Expected Performance; Maximum D: biggest observed difference; Chi-square: calculated in accordance with Equation (3) ; P-value: calculated in accordance with the equation  $\alpha = e^{(-0.5D^2)}$ .

In the present study, the p-value obtained as described above was 0.8317, meaning that there is no significant difference between the Target Type and the Real Target at a level of significance of 0.05. This means that the organizational psychologists managed to obtain the incorporated

boldness profile in the software. Thus, the artifact clearly distinguished the various types of respondents in the roles embodied by organizational psychologists.

## Discussion

Geletkanycz and Tepper (2012) claim that “discussion sections encompass several dimensions, including practical implications, study limitations, and future research, each of distinct importance, and thus requisite components of any complete discussion” (p. 256). These are the topics addressed in this section.

## Practical implications

The study has diverse practical implications, mainly directed at micro and small entrepreneurs. It can also be applied to other social dimensions of organizational studies. The artifact for measuring the degree of boldness of entrepreneurs who generally begin their businesses with small companies implies, in practice, that the entrepreneur is capable of knowing his boldness profile before beginning his business. This knowledge can be important when creating the business structure or, at an earlier stage, when defining the future business.

As said above, Eysenck and Wilson (1975) considered the tendency of social subjects to take or not take risks as consequences of eventual ventures. Naturally, an entrepreneur with a higher degree of boldness will be inclined to create and manage businesses that involve higher risks in more dynamic and competitive markets that require greater creativity, but with a tendency to include greater economic competition and social participation. A good example would be the intention of a small entrepreneur to open a business in the IT sector (developing games). If the entrepreneur has a low score in boldness, he might find it preferable to start out with a business with more stable characteristics, less volatility, and less economic and social competitiveness. There would be less need for creativity and fewer risks to his business, but also lower economic and social returns. Another example would be an entrepreneur opening a business in the pet shop sector. In any case, the entrepreneur’s use of the Boldness Calculator artifact could make his choice and structuring of his business more assertive and at the same time help reduce the rate of small and micro businesses that die young.

Another practical implication of the artifact lies in applying it to collaborators when considering managerial promotions in diverse sectors of the organization. This type of application could make a welcome contribution to organizations due to the multidisciplinary nature and scope of the theory of Eysenck and Wilson (1975). Using the same logic applied to small and micro entrepreneurs, the test could be given to collaborators at the managerial level to determine their degree of boldness. This measure could help reveal to which function or area of the organization a collaborator could best adapt. It could aid assertiveness when deciding to promote, or not promote, a collaborator whose boldness profile is not right for the position available at that time. It could also reduce the failure rate of collaborators that do not adapt to new functions in different sectors of the organization or even in the same sector, as they do not have the level of

boldness required to head teams with certain characteristics. This type of occurrence can have serious social consequences for the collaborator and the organization, which will later have to deal with the unsuccessful change.

## Study limitations

The present study addressed the specific viewpoints of organizational psychologists, who, by consensus, operated the Causal Determinant software to determine the causal factors of entrepreneurial boldness. Although the choice involved a consensual logical analysis, the result could have been different with other operators. This same group of organizational psychologists selected the 10 questions extracted from each questionnaire on the factors that originally contained 30 questions each. Obviously, other questions could have been selected if other psychologists had been used. These two topics on their own explain the initial difficulties faced when constructing the artifact. Another limitation is the form of validation that did not follow the technique of simply submitting the software to the user. It made advances by asking the tester to incorporate a certain profile. As the testers were organizational psychologists, the method is believed to be acceptable, but difficult to replicate with the same results. These aspects, however, can hardly be said to limit or compromise the validation of the artifact.

## Future research

This study was conducted using 30 organizational psychologists selected by convenience to test the artifact and give their opinions on it. The results validated the rigor and reliability of the artifact. We expect that in the future, with the development and adjustments of the artifact, further research should explore a deeper theoretical basis about the issue and apply the research on business social actors.

For example, one natural evolution of the research, using this artifact, could be its application to micro and/or small entrepreneurs and/or other business social actors to investigate whether their degree of boldness is associated with the risk of the organization or some other organizational characteristic. The study could also consider, in addition to measuring boldness, the characteristics of the businesses these entrepreneurs are developing, and observe their possible association, or lack thereof. Other studies could be conducted with future entrepreneurs associated with agencies that support micro and small businesses, or even incubators.

Along with the practical implications described above, it appears interesting to conduct studies using the software on managers of organizations of any size. In addition to measuring their degrees of boldness, the study could also attempt to describe the functions to which these individuals are assigned in the organization to determine how well they conform.

## Conclusions

This work proposes a method and corresponding artifact based on the protocols of Design Science to measure the degree of boldness of subjects, especially entrepreneurs and businesspeople. The aims of the study appear to have been achieved in that this work proposes a method and corresponding artifact to measure the degree of boldness of subjects, especially entrepreneurs and businesspeople, which is easy to operate and meets theoretical assumptions.

To construct the artifact, the work of Eysenck and Wilson (1975) was used. This theoretical framework is justified by the considerations of West (2012), especially the part associated with determining a subject's degree of boldness, operationalized by the KSG test supported by the observations of Schindler (2008) and Siegel (1960).

The methodological approach used was Design Science, as the present object of study is considered an information artifact and, as such, has functions of data processing, reducing entropy (vision of syntax), forming meaning (vision of representation), and achieving viability (vision of adaptation). To ensure the validity of the study, a sample of users made up of 30 organizational psychologists was used (selected by convenience), which incorporated a type of respondent, referred to as the target type, instead of simply operating the artifact as typical users.

The main outcome is the one that originated from the analysis of the validation test of the artifact using the sample of 30 organizational psychologists. The p-value obtained (0.8317) shows, at a level of significance of 0.05, that there is no significant difference between the Target Types produced by the organizational psychologists and the randomly pre-specified Real Targets. This means that the organizational psychologists succeeded in obtaining the incorporated profile of boldness in the software.

The present study dealt with the specific views of the organizational psychologists, who, by consensus, operated the Causal Determinant software to determine the causal factors of an entrepreneur's boldness. Although the choice involved a consensual logical analysis, the result could have been different if other operators had been used. These aspects, however, hardly limit the validation of the artifact.

The study has a number of implications for managerial practice since by using the artifact it is possible to measure an entrepreneur's degree of boldness and allow more assertive choices and structuring of their business, all the while reducing the rate of micro and small businesses that die early. Another practical implication of the artifact lies in its application to collaborators when it comes to promoting people to managerial positions in diverse sectors of organizations, which will certainly make a positive contribution to organizations. In the academic field, the artifact will enable research on the degree of boldness of businesspeople with diverse other organizational variables.

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## Author contributions


- 1<sup>st</sup> author: conceptualization (lead), investigation (lead), supervision (lead).  
2<sup>nd</sup> author: formal analysis (equal), methodology (equal), writing-original draft (equal).  
3<sup>rd</sup> author: investigation (equal), methodology (equal), validation (equal).  
4<sup>th</sup> author: methodology (equal), software (lead).  
5<sup>th</sup> author: investigation (supporting), methodology (equal), writing-review and editing (lead).

## Authors


### Nelson Rogeri

Centro Universitário Campo Limpo Paulista  
Rua Guatemala, 167, Jardim América, 13231-230, Campo Limpo Paulista, SP, Brazil  
nelson.rogeri@gmail.com  
 <https://orcid.org/0000-0003-0339-6277>


### Manuel Meireles

Centro Universitário Campo Limpo Paulista  
Rua Guatemala, 167, Jardim América, 13231-230, Campo Limpo Paulista, SP, Brazil  
meireles@faccamp.br  
 <https://orcid.org/0000-0002-9917-7863>


### Cida Sanches

Centro Universitário Campo Limpo Paulista  
Rua Guatemala, 167, Jardim América, 13231-230, Campo Limpo Paulista, SP, Brazil  
cidasanches@uol.com.br  
 <https://orcid.org/0000-0002-1726-9976>

### Samuel Ferreira Jr.

Centro Universitário Campo Limpo Paulista  
Rua Guatemala, 167, Jardim América, 13231-230, Campo Limpo Paulista, SP, Brazil  
samuel.f@terra.com.br  
 <https://orcid.org/0000-0002-5910-749X>

### Marcio Luiz Marietto

Instituto Politécnico de Leiria, globADVANTAGE – Center of Research in International Business & Strategy  
Morro do Lena, Alto Vieiro, 2411-901, Leiria, Portugal  
profmarcioluiz@uol.com.br  
 <https://orcid.org/0000-0003-1526-6058>

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